Service Science and Management Research (SSMR) Volume 4, 2015 www.seipub.org/ssmr
doi: 10.14355/ssmr.2015.04.001

An Image-based Approach for Drug Verification: An Initial Experience

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Abstract

Although drug dispensing may be automated to improve accuracy, it is still done manually in many clinics, hospitals, and drug stores. The manual process is prone to human errors that may cause disastrous consequences. In this work, we propose an image-based approach for drug verification to improve accuracy in drug dispensing. The initial experience found in this research is very encouraging.

Keywords

Drug Verification; Dispensing Logistics; Risk Reduction; Image

Introduction

Drug dispensing is often manually done in clinics, hospitals, and drug stores. This manual process is prone to human errors and this error-prone process may pose a threat onto public health and safety. Although automated solutions have been developed to improve accuracy, they have not been widely adopted. In this work, we propose an image-based approach for drug verification to assist pharmists in dispensing drugs. A simple prototype has been built for experimental purpose. Our initial experience with our prototype is very encouraging.

Background And Literature

Drug dispensing is a process involving the preparation, packaging, labeling, record keeping, and transfer of a prescription drug to a patient or an intermediary, who is responsible for administration of the drug. In terms of the drug supply chain management, drug dispensing is a converging point of various drug supply chains as well as a distribution point for picking and packing drugs from different pharmaceutical companies according to different independent prescriptions for individual patients. The responsibility of safe-guarding the accuracy of deliveries of prescribed drugs to corresponding patients as part of their medical treatments is entirely relied on pharmacists and trained staff in pharmacies. In a 2003 study of prescription dispensing accuracy and safety in 50 U.S. pharmacies, there was 98.3% accuracy in dispensing medications [1]. Nonetheless, the 1.7% inaccuracy rate over 3 billion medications dispensed per year might result with about 51 million dispensing errors per year or 4 errors per day per 250 prescriptions filled. Any errors may evoke safety concern. In 2000, the impact of drug-related medical errors resulted estimated annual deaths of 44,000 to 98,000 [4].

The drug dispensing process is a labor-intensive process [2]. A study by the Massachusetts Board of Registration in Pharmacy revealed that pharmacists perceived a number of different elements, listed below, as causative factors for drug dispensing errors [3]. All perceived factors are related to human nature, working environment, and time-pressing conditions.

- Too many telephone calls (62%)
- Overload/unusually busy day (59%)
- Too many customers (53%)
- Lack of concentration (41%)
- No one available to double-check (41%)

- Staff shortage (32%)
- Similar drug names (29%)
- No time to counsel (29%)
- Illegible prescription (26%)
- Misinterpreted prescription (24%)

In addition, the top three dispensing errors include dispensing an incorrect medication, dosage strength, or dosage form; dosage miscalculations; and failure to identify drug interactions or contraindications [1]. Although there has been automated drug dispensing system available for doing automatic drug pick-and-pack according to each prescription, the deployment of such systems may not be suitable for all pharmacies or solve all drug dispensing errors.

Our Proposed Prototype

In this work, an image-based drug verification mechanism is proposed to strengthen the drug dispensing process and to enhance safety of administration of the drug. Figure 1 depicts the safety of drug dispensing and consumption in three areas that involve manually handling of drug. The first image-based drug verification mechanism is applied in a pharmacy to verify drug picked for corresponding prescription before drug dispensing. If the prescription is for inpatient, a nurse will make use of the image-based drug verification to ensure the correctness of administration of the drug to corresponding patient. If the prescription is for outpatient, a patient will make use of the verification mechanism to ensure the correctness of the consumption.

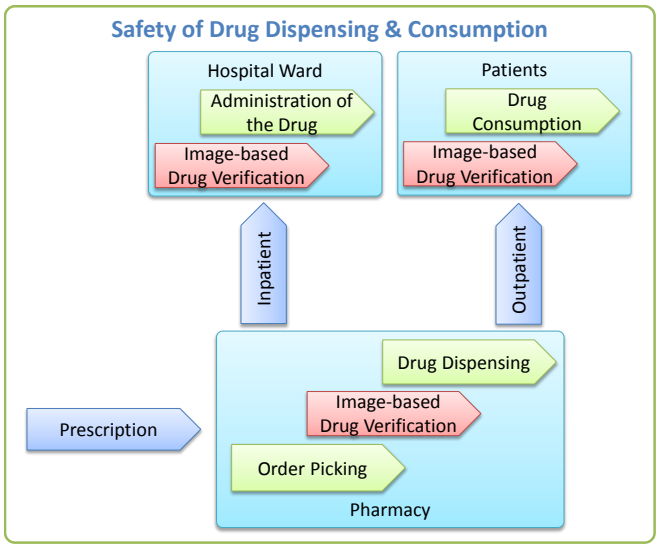

FIG. 1 IMAGE-BASED DRUG VERIFICATION

In the first tier defense in pharmacy, a quick and objective drug verification warning system is introduced to ensure the accuracy of drug being picked for a specific prescription and drug consumption. Drugs are commonly manufactured in the form of pills or capsules. According to the Pill Identification Tool by WebMD [5], medication can be classified in 12 shapes such as round, oblong, and square, as well as in 15 colors such as white, off white, and peach. However, there are over 19,000 drugs that are being registered in Hong Kong and a small-to-mid sized pharmacy may have 2,500 drugs in stocks ready for meeting the needs of most prescriptions. The current drug verification mechanism relies solely on pharmacists' expertise and memory of all available drugs to visually verify whether a set of drugs being picked matches the corresponding prescription.

The second tier defense in hospital ward offers a visual tool for nurses to perform final drug verification along with current practices of verifying patient before administrating the drug. In hospital, different sets of prescribed drugs are usually delivered in batch from pharmacy to various hospital wards. There is a chance that inappropriate drugs may be delivered to corresponding patients. A visual drug verification tool may help nurses ensure the correctness

of administration of the drug. Regarding outpatient, a visual verification tool may help patients identify the correct set of drugs for each drug consumption.

This proposed project is to design and develop an image-based drug verification mechanism that includes image object recognition, drug image database, prescription coding, and feedback channel. The image object recognition will extract image features from captured images and perform feature vector matching with images in the drug image database. Low-level feature extractions such as edge detection, blob detection, and color histograms will be implemented. Object orientation and size will be normalized to accommodate any variation of image capturing.

Figure 2 depicts image feature extraction from live captured image of packaged drug and the comparison of those image features with a database image in a control environment. Figure 3 shows image recognition of captured image based on a set of low-level extracted image features also in a control environment. High-level feature composition will be established to create object identity to facilitate the image matching process. A control environment will be applied into the image object recognition in the drug verification in pharmacy to achieve fast and accurate verification performance. Figure 4 shows an image-based drug verification system capturing a drug image through a video camera for performing image matching.

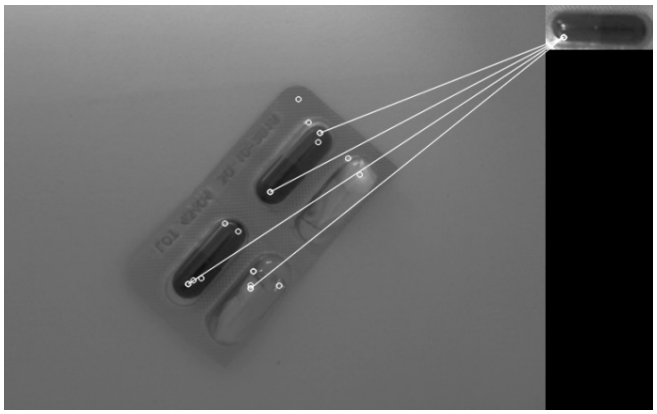

FIG. 2 IMAGE FEATURE EXTRACTION OF PACKAGED PILLS CAPTURED IN THE LARGE LEFT PANE FOR MATCHING WITH FEATURES IN IMAGE DATABASE

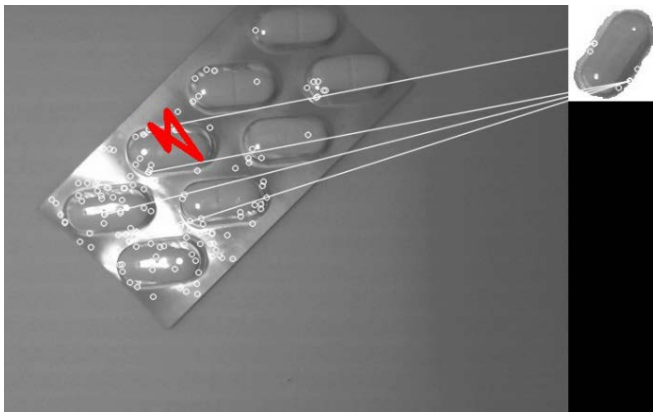

FIG. 3 IMAGE FEATURE EXTRACTION OF PACKAGED PILLS CAPTURED IN THE LARGE LEFT PANE FOR MATCHING WITH FEATURES IN IMAGE DATABASE

The drug image database will captured images of all drugs available in a pharmacy. The image capturing process will be done in both control environment and normal room environment. The same control environment will be used in the image object recognition process for facilitating high throughput workflow environment in pharmacy. The images from normal room environment will facilitate the use portable camera for taking drug image for performing verification process. In order to ensure the matching of a picked drug with its prescription, prescription coding will be defined to instruct the drug verification process what to look for as the verification results. The feedback channel can be a warning signal, a display of matched drugs, and printed matching results for pharmacists or patients.

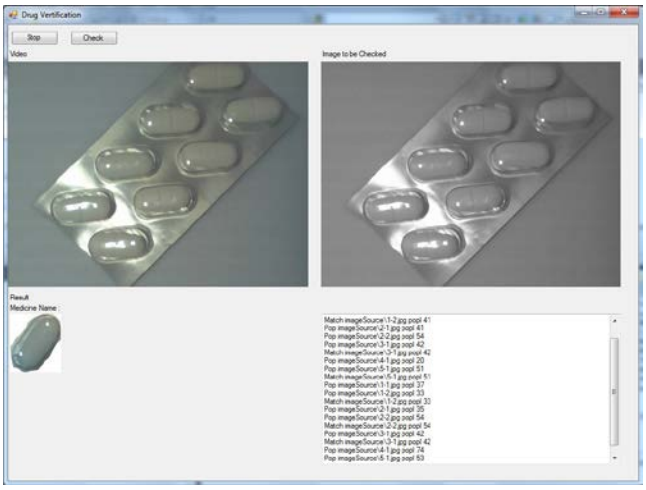

FIG. 4 IMAGE CAPTURED THROUGH A VIDEO CAMERA FOR MATCHING IMAGE IN DATABASE

Conclusions

In this work, we propose an image-based approach to reduce risk in drug dispensing. The goal of the proposal is to improve accuracy in a manual dispensing process. A prototype of the system has been proposed and built. We find that the experience with our prototype is very encouraging.

ACKNOWLEDGMENT

This work is substantially supported by a research grant from Asian Institute of Supply Chain and Logistics, Hong Kong (Grant No. 8116028).

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